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Mountains resemble marine climates in having higher wind velocities than continental lowlands; mountain summits have a nocturnal maximum of wind velocity, while plateaux usually have a diurnal maximum. Mountains both modify the general, and give rise to local, winds. Among the latter the well-known mountain and valley winds are often of considerable hygienic importance in their control of the diurnal period of humidity, cloudiness, and rainfall, the ascending wind of daytime tending to give clouds and rain aloft, while the opposite conditions prevail at night. The high temperature and dryness of the *foehn*, which is of immense benefit to man by reason of its melting and evaporating powers, although often enervating and depressing, result from the fact of a descent of the air from a mountain slope or summit. The bora, with its cold gusts, is a wind in whose development a mountain or plateau is essential. And the mistral of Southern France owes some of its cold to radiation over the interior plateaux.

*Mountains as Climatic Divides.*—Very different conditions of temperature, pressure, and humidity may be found on the opposite sides of a well-defined mountain range, because such a range interferes with the free horizontal interchange of the lower air. Mountain ranges which trend east and west, like the Alps and the Himalayas, separate more severe from less severe climates; those which follow a coast-line, as in the case of California, Scandinavia, or eastern Siberia, separate marine from continental. Large differences of pressure on the two sides may be equalized by a flow of air across the mountain, as in the *foehn*.

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## AMONG THE MOUNTAINS OF SHEN-SI.

BY

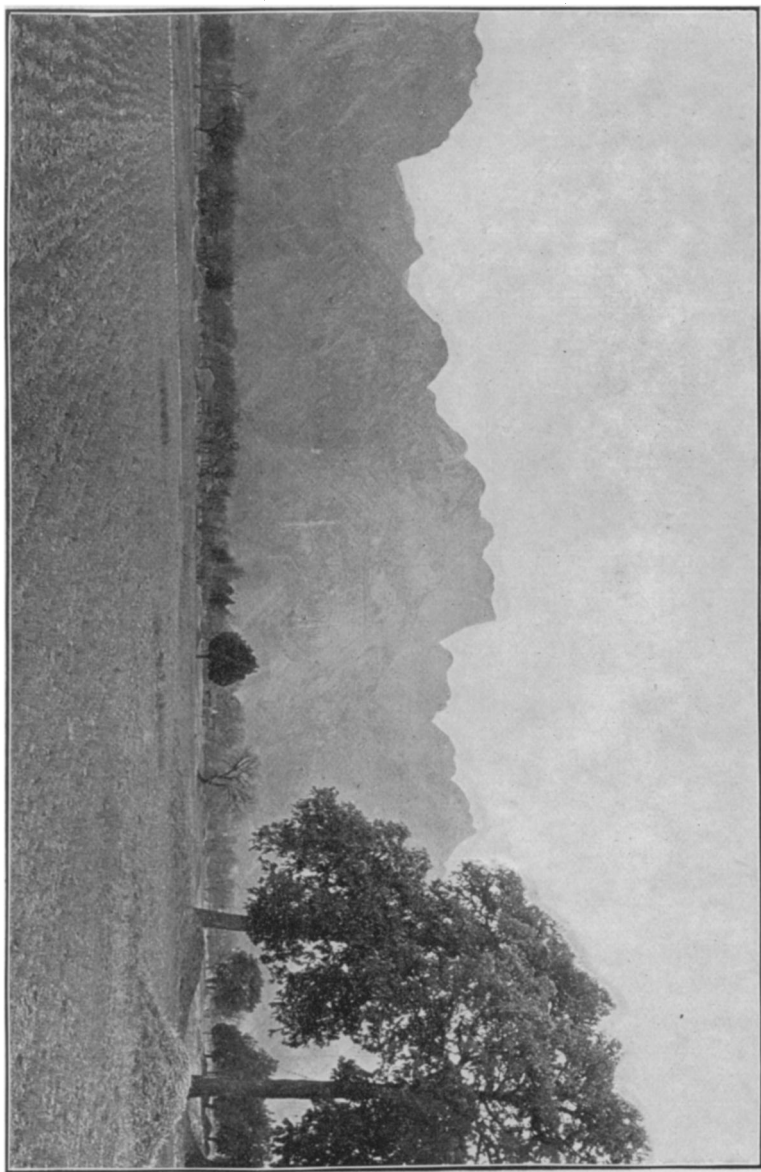
BAILEY WILLIS.

In the province of the Western Passes, Shen-si, among the outliers of the Tibetan Mountains, six hundred miles southwest of Peking, spreads a rich valley. The Wei River flows through it from west to east, and the Huang-ho, entering it from the north, turns sharply eastward and leaves it by a cañon which leads to the great plains. In extent this valley of the Wei is not unlike that of the Mohawk in northern New York, or that of the upper Danube in southern Germany. It is a wide and fertile plain,

shut in among mountains, but through it pass the great highways of the continent, and it has been the scene of historic events, the centre of dynasties, for more than three thousand years. South-east of this valley rises the Hua-shan, a granite range whose bold cliffs compare with those of the Yosemite. Their grandeur is enhanced by contrast with the level plain, the base from which they tower abruptly without intervening slopes. The Hua-shan is one of the five sacred mountains of China, and on its summit, four thousand feet above the plain, are monasteries, which are reached by means of irons and chains set in the rocks. Westward from its highest point the crest of the range declines, the face becomes less precipitous, and the ridge sinks at length beneath the valley plain. The traveller who rounds it sees to the south another great mountain chain, the Ts'in-ling-shan, which stretches westward as far as the eye can reach and ultimately merges in the High Plateaux of Central Asia. It has been called the Barrier Range of China; for, as the Alps divide Germany and Italy, so the Ts'in-ling-shan separates North China from South. Among the many more or less difficult paths by which it may be crossed by mountaineers there is but one pass which Nature has opened across it. Toward its eastern end, where it becomes tangent to the southern slope of the Hua-shan, only a low divide separates a tributary of the Wei River from the T'ang-ho, a tributary of the Han and the Yang-tze, and through this pass lies one of the great historic routes of migration and commerce, from the plains of southeastern China to central Asia and Europe. A second highway passes the eastern end of the Hua-shan. It is that which leads southwest from Peking, through Shan-si into the valley of the Wei, and which continues thence southwestward across the Ts'in-ling-shan to the rich province of Sze-chwan, the upper Yang-tze, and India. The passage of the barrier range is accomplished by a military road said to have been laid out by the Emperor Ts'in, the builder of the Great Wall, 255-206 B. C. In the later history of the rise and fall of Chinese dynasties it was long neglected and but partly rebuilt. Though it excited the astonishment of the Tyrolean Father Martini, in the middle of the seventeenth century, it had sunk in von Richthofen's day, 1880, to the condition of a wretched mule path, scarcely practicable for pack animals.

At the foot of the mountains where the roads meet from the Yang-tze, from Peking, from Tibet, and from India is a great commercial city, Si-ngan-fu. Its history is rooted in the myths of the earliest Chinese traditions. Eleven hundred years before Christ it

HUASHAN,  
IN THE PROVINCE OF SHEN-SI. ONE OF THE FIVE SACRED MOUNTAINS OF CHINA, AS SEEN FROM THE VALLEY OF THE WEI.



was the capital of the Chou dynasty, and for many centuries it continued to be an imperial city. It was the most eastern point known to Ptolemy, the geographer, and by Marco Polo was described thus:

And when you have travelled those eight days' journey, you come to that great city which I mentioned, called Kenjanfu. A very great and fine city it is, and the capitol of the kingdom of Kenjanfu, which, in the old times, was a noble, rich and powerful realm, and had many great and wealthy and puissant kings. But now the king thereof is a prince called Mangalai, the son of the Great Kaan, who hath given him this realm, and crowned him king thereof. It is a city of great trade and industry. They have great abundance of silk, from which they weave clothes of silk and gold of divers kinds, and they also manufacture all sorts of equipments for an army. They have every necessary of man's life very cheap. The city lies towards the west; the people are Idolators; and outside the city is the palace of the Prince Mangalai, crowned king, and son of the great Kaan, as I told you before.

In recent times the old city, long deserted by royalty, once more became the imperial residence. The Empress, when she fled from Peking, took up her abode there, ostensibly to do honour to the ancient emperors, but in fact to get as far as possible from the invading barbarians. To-day the city has returned to those pursuits of commerce which its geographic position naturally determines, and the people are happier than when the hordes of hangers-on of the Court devoured their substance and the price of food became exorbitant even in the fertile valley of the Wei. The road from Peking to Si-ngan-fu was prepared for the royal progress by grading away ruts and covering the surface with yellow earth; all traffic was suspended for two weeks, and the communities and carters suffered accordingly. One still heard mutterings against the Empress for having the people's interest so little at heart when, three years later, I followed the route of her flight.

The people along the road still cursed the Empress when I passed that way four years later. Coming from the direction of Peking, the historic highway crosses the Yellow River at the Tung-kuan, a fortress of strategic importance in the T'ai-ping rebellion and earlier wars, but now easily within reach of artillery from the high terrace north of the river. Thence it passes beneath the lofty crags of the Hua-shan and, a few miles from Si-ngan-fu, reaches the hot springs of Lin-tung. A journey of three weeks in Chinese carts, through the loess country of Shan-si, prepares the traveller for rest and the rare pleasure of a bath. The impalpable yellow dust of the roads through the loess penetrates every garment and the very pores of the skin, and one who has not experienced it can scarcely imagine the choking sensation with which you ride hour after hour in its yellow cloud. I had sent our Chinese boys ahead, and expected, on arriving at Lin-tung, to find comfortable quarters ready for our

reception; but instead, our loaded carts stood outside the enclosure about the springs, and Li, our head boy, was engaged in angry altercation with the servants in charge of the Kung-kuan, the official hostelry. Stick in hand, the loyal but excitable fellow was ready to lay about him with a will, when I appeared. He was insulted in our behalf at the wretched pools in which they suggested we might bathe, and which were commonly used by coolies. I was angered, too; but firmness and dignity go farther in China than threats or blows, and by their use we soon opened the doors to the official apartments. There were airy reception-rooms looking out upon a pleasant court, and private rooms adjoining, in each of which was a deep square tank of stone filled with an overflowing current of hot water, 104° Fahr., into which a flight of steps led down. Close by were the garden, pavilion, and bath used by the Empress during her residence at Si-ngan-fu. The bushes were growing over the paths, and the buildings, stripped of their hangings and furniture, were desolate; but pacing the terrace before the Empress' private apartment, looking down upon the pretty pavilion on an island in the bubbling pool, or out across the walls to the expanse of plain and lofty mountains, one pondered what influences had wrought upon the remarkable woman who, returned to Peking, has reversed her whole course of action, and now welcomes the aliens from whom she once fled. Her course presents, in the full glare of publicity, a change of front such as the Chinese not infrequently execute when necessity commands—and execute, too, with a grace which converts the necessity into a voluntary purpose.

Si-ngan-fu is the residence of the Governor of Shen-si, and our reception was for us a matter of importance, as likely to indicate the attitude of that official toward the surveys we wished to prosecute. Passports and letters of introduction had preceded us, and we had every reason to expect that courtesy which had been extended to us elsewhere; but though we had travelled several days in the province, no message of greeting had come from the Governor, and his subordinates, the magistrates residing in the chief towns along the way, had no instructions concerning our party. On leaving Shan-si we had rewarded and dismissed the four faithful cavalymen who, by order of the Governor of that province, had accompanied us three hundred miles on our journey, and we were now travelling unattended toward the city. The great road crosses a tributary of the Wei, on a fine stone bridge a quarter of a mile in length, and one sees the massive walls of the city, fifty feet high, with crenelated battlements and huge gate towers, rising

from the higher plain. Along the highway outside the wall, for something more than two miles, stretches a densely-built suburb of shops and dwellings, many enterprising merchants having establishments outside the gate to avoid the city tax on produce and goods which pass in. We approached from the north, and rode in carts slowly through the busy throngs of the suburbs, along one of the two principal streets which cross at right angles in a central tower, a heavy structure with four arches covering the intersecting streets. There the congested traffic is forced into still narrower space, in which there is scarcely room for two carts to pass, and yet on either hand vendors of trifles and eatables establish their stands, and coolies, eating bowls of rice or soup, sit unmoved, though the long projecting axles graze their backs. Here one may see every grade of Chinese society, from the beggars who sit before shop doors picking vermin from their rags till paid to move on, to the high official who comes in his sedan chair, preceded by horsemen and footmen and the blare of trumpets. All outside official rank jostle elbows in the crowd—the labourer, the hawker of trifles, the banker, and the scholar. And the labourer's son, as well as the banker's or the scholar's, if he have ability and learn, may come to ride in his chair with banners and trumpets going before him.

There being no one to direct us to the quarters usually provided by official courtesy, we pressed through the moving throng to an inn, the only one available—a dark, noisome place reeking with filth. Our cards were sent to the Foreign Office, and then ensued an exchange of profound regrets—regrets on the part of the official whose duty it was to receive us that the city was so wretchedly poor there was no suitable place to entertain such distinguished visitors; regrets on my part that so eminent and learned a man as he must be should so disgrace himself by allowing strangers to remain in lodgings so unfit. After two days of courteous but unwavering insistence, we were recognized and were given decent accommodations. Interviews with the officials, military and civil, including the Governor, followed, and the obstacles which had threatened to stop our further explorations vanished. We found the Governor, if not progressive, intelligent and friendly; and let me say that he was justified, unfortunately, in receiving foreigners with suspicion. Some months before there had come one, a traveller from Europe through central Asia, whom we had to thank for our reception here as well as for that at the hot springs of Lin-tung. With vile language and brutal temper

he had demanded everything, paid for nothing, and beaten the servants sent to attend him. True, he was an uncommon brute; but there are too many of his kind. The Chinese gentleman is not without reason in seeking to assure himself that the foreigner is not "ignorant of restraint."

From Si-ngan-fu our route lay southward across the Ts'in-ling-shan to the Han River. We did not wish to tread the well-known routes of the great highways; we asked about by-ways, and prepared to abandon the comfort of Chinese inns for tents in the wilderness. The many coolies required to carry food made a striking procession as they straggled out from Chou-ch'ih-hien, the town in which we assembled the outfit for our start. The day was showery, and the men went bare-legged, shod with grass sandals, their blue blouses tucked up and their huge umbrella-like hats tied under their chins. Spring had come in the valley of the Wei. Wheat and poppy fields were green, violets and lupine blossomed, the trees were opening their buds, and the scent of moist earth filled the air. Heavy clouds still hid the Ts'in-ling-shan after three weeks of rain, and the mountain streams were foaming torrents.

We could learn but little concerning the route ahead, and were warned not to attempt the mountain paths and fords; so, leaving my two American comrades and the coolie caravan to work their way slowly into the defiles of the northern front, I pressed ahead with Li and a single mountaineer, to reconnoitre. It is well said in China you cannot get out of sight of the Chinese; even in the Ts'in-ling-shan they inhabit every nook, and footpaths lead everywhere. Wild, rough trails they are, unfit for even donkeys; constantly crossing and recrossing the torrential streams, occasionally carried around a cliff along poles or boards, supported on rotting props stuck in the rocks. The mountain face rises abruptly, the cañons are deep and narrow from their mouths inwards, and soon the steep and jagged spurs shut out all view but the rocks, the foliage, and the clear, brawling river. Along the footpath is here and there a hut, and one meets the poorest of the poor carrying out heavy loads of coffin boards. Sawed out where the tree grows, these are about three inches thick, eight feet long, and a foot to eighteen inches wide. Four of them, slung on a man's back so that one end rests on the ground when he stands upright, but is raised from it as he bends forward, make a staggering load. Steadying himself by two poles shod with iron the bearer crawls slowly along the dangerous path. Glancing up as they met me,



these men looked dumb amazement; they were too slow to catch a passing remark, but where I stopped among them they were quiet and obliging. Sometimes I slept outside their huts, in the shelter of a boulder or cliff. One night I was housed in an inn which they frequented. There was a big room, where the kang, the clay sleeping platform, was heated for all comers to share; the one great cast-iron bowl served to boil whatever any one brought, and the smoke, steam, and human reek were breathed by all alike. I stayed in it long enough to get a distinct impression of the Devil's reception-room in Hades, and was glad of a corner in a storeroom, which Li had found and made comfortable.

The first foreigner to tread that trail, I was an object of intense curiosity; but I was not annoyed. Children came to stare and stayed to be amused; the older ones of the family passed through oftener, perhaps, than their avocations required, but the vulgar impertinence of village crowds was not apparent. The innkeeper's wife came and went about her business. She was shabbily dressed, but wore silver earrings, two finger rings, and a bracelet. From the bag of flour she weighed out portions with a steelyard and basket that she balanced accurately. All food is carried in, and flour costs fifty cash a catty, as against twenty-eight in the plains below. The villagers are woodcutters; they drive logs on the stream with spiked poles, much as we do, but their logs are rarely more than a foot through and eight feet long. There are two distinct ethnological types among these people. The one is of pale yellow complexion, with well-developed nose and straight eyes; the cheek-bones are high and the jaws slender. It is a type we see in north China, where the slanting almond eye of the southern Chinese is not the rule. The other face is very broad and flat, the eyes set in long straight slits and far apart; where the bridge of the nose should be is a hollow, and the wide nostrils expand under a turned-up tip of a nose. The mouth is very large, the expression dull but very good-natured. Both men and women are remarkably short, but very broad and strong. I took the latter type to be survivors of an aboriginal race, or remnants of a distinct immigration, which elsewhere has been absorbed by the dominant Chinese.

After several days' absence, I returned from the summit of the Ts'in-ling-shan to my comrades, who had made their way up the cañon of the Hei-shui-ho. The reconnoissance having made it evident that we must carry more food and be prepared for greater delays than we had anticipated, Li was sent out with

fifteen coolies to bring in rice. Before he could return the Hei-shui-ho was swollen by continuous rains to a flood which cut us off in all directions, so we prepared to wait as patiently as we might for Li's return, and were astonished when he appeared early one morning with his heavily-loaded men. After trying the fords and finding them impassable, he had built a raft; and having put the rice upon it, he and the coolies had swum the river, pushing it before them. They thus reached a dangerous track, which had once been a pathway on the eastern bank but was washed out and abandoned, and along this they made their way to us.

From our camp on the Hei-shui-ho the path led up from the cañon to gently-moulded spurs of the still higher mountain summits, presenting a contrast such as may be seen in North Carolina, in Norway, and many other mountain districts where an old hill country has been rapidly uplifted to mountainous altitude and sharply and deeply cut by the rivers. The heights had once been timbered; and though the climate above 5,000 feet is severe, they had been to some extent cultivated while lumbering flourished. Then our route was frequented by merchants, and the inns did a profitable business; but in those days life was not any too secure in these remote fastnesses. If a lonely traveller was seen to have money, he was made away with at one inn or the next, the landlords being leagued together, and his body was easily disposed of. One wonders why, with the cañon close at hand, the victims should have been buried; yet we were shown a pit near one of the houses in which it was said a large number of skeletons had been found, when justice finally overtook the murderers.

At the little village of Siau-wön-kien we found thirty or forty people remaining from a population that had once numbered several hundred. Abandoned houses and stores were in ruins, and a richly-painted idol of Kwang-shöng-ti, the protector of the people, continued to gaze fiercely but helplessly on a scene of destitution. The wealth of the place had vanished with the utter destruction of the forest. A disease had attacked the potatoes, the oats had failed, and wild hogs, appearing in droves, had become a pest against which the farmers could not protect themselves. In one case we saw fields freshly uprooted, and near-by was a newly-abandoned house. And yet here, in this poverty-stricken community, a gift was volunteered by the head man; a basketful of potatoes and walnuts, a white chicken, a little maccaroni, and some oat flour. He came accompanied by two or three friends, and talked with us a few moments—his first interview with foreigners.

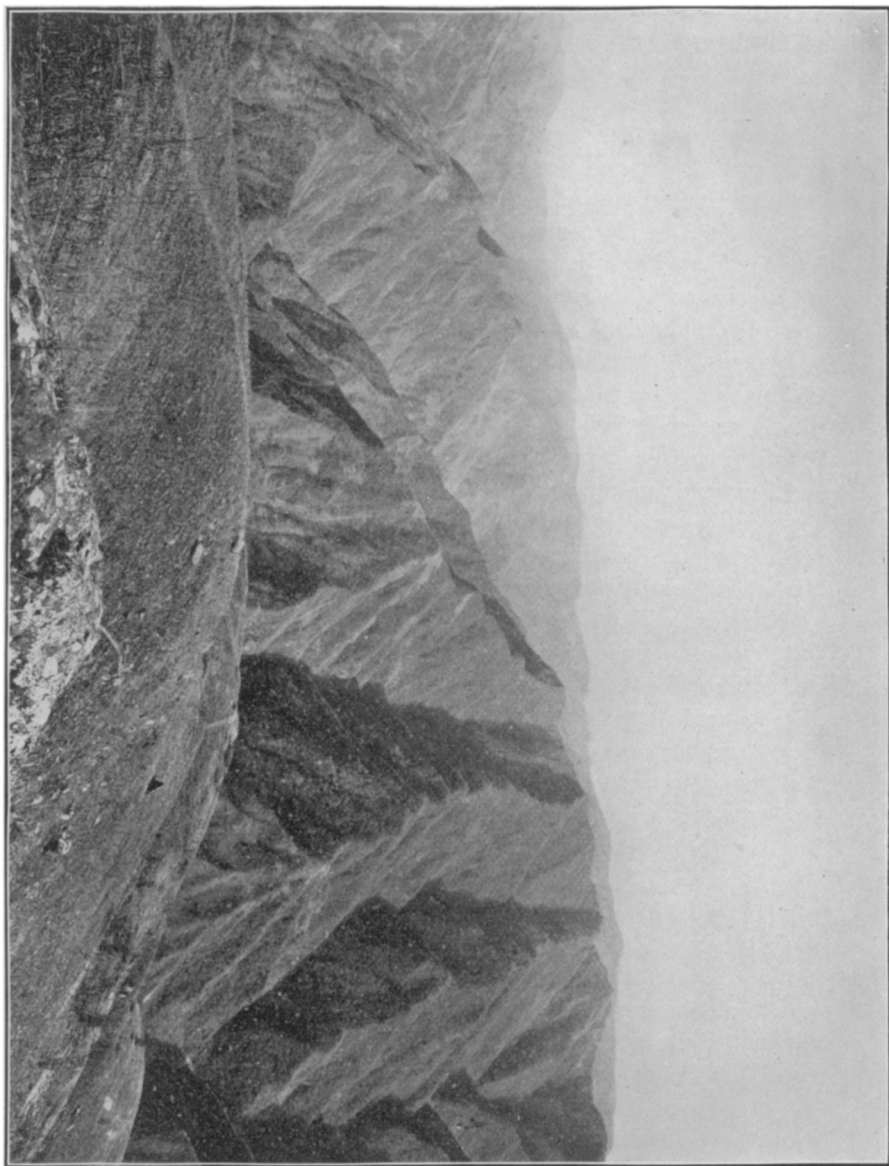
I was at a loss for an equivalent gift, our supply being low and not well suited to the villagers' needs, but I bethought me of the generous outfit of thread, needles, and pins which had been provided for my own use. Four needles, two rows of pins, two safety-pins, eight hooks and eyes, a spool of cotton, and a cake of chocolate made up the return gift. Li told me it gave much pleasure, most of the articles being the first of their kind the people had seen. Needles they had, coarse Chinese ones, but not such cotton thread—so strong, so smooth.

Approaching Siau-wön-kien, the route taken by our coolies again led through a gorge and often crossed the flooded river. One of the bearers, an old man, was swept away by the stream and roughly handled among the boulders before he was rescued. It was reported that he was drowned, but he was presently brought to meet me as I hastened to see what might be done for him. Trembling with fear, his ragged clothes clinging to him, the poor old fellow threw himself on hands and knees before me and struck his forehead on the ground. He was imploring pardon for having wet his pack! I raised him and again he prostrated himself. Then one of the boys told him to stand up, and he stood, but shivering from chill and nervous shock. We poured him hot brandy and water, which he drank eagerly; then one of our T'ients'in boys, whose good heart we had more than once had occasion to recognize, took the old man into a room, rubbed him down hard, and lent him dry clothes. Later I called my boy: "Sha-ehr-ko!" "Yees, sir." "How old man?" "Old man very hot, sir; very hot."

From Siau-wön-kien to the foot of the pass, a distance of twelve miles, we were told to expect forty fords; and we certainly realized them, though the flood had somewhat run down before we attempted them. In its upper stretches the river had become a jolly, rollicking, boisterous stream, with many rapids and falls over ledges of hard rock, which also form bolder cliffs than the banks of slate farther down. By many of the fords a little shrine was built in the cliff, and within were grotesque dolls, idols to which the mountaineers pray before trying to cross. As offerings to the spirit of the place they also place on end, on convenient ledges above the stream, long stones, simply picked up in the shingle. This custom, which was evidently much practised, has its origin in India.

We crossed the range at a pass marked by the ruins of an old temple called the Wön-kung-miau, and at an elevation of only 7,700 feet. The highest summit near-by was 9,700—a broad-

SUMMITS OF THE TS'IN-LING-SHAN, THE BARRIER RANGE OF CHINA, LOOKING SOUTH TO THE MAIN DIVIDE. HEIGHTS, 8,000 TO 10,000 FEET.



shouldered, massive mountain, and the general altitude of the hills on many ridges reaching far to the northeast and south was about 8,500 feet. Thirty miles to the southwest the Ta-pai-shan, a range marked on many European maps, towered to 11,500 feet, and in the latter part of April was still covered with snow, which probably does not altogether disappear during the summer. The Ts'in-ling-shan is thus not a sharply-defined mountain chain, but a broad, even-topped uplift, carved by streams which flow in their principal courses north or south, with only a subordinate development of east-west valleys parallel to the range and the structure of the rocks. The northward-flowing streams fall 6,000 feet in thirty miles, to the valley of the Wei; those which flow southward have no greater total fall in seventy miles, to the valley of the Han. The northern spurs have a cold winter, wet spring, and short summer; the southern slopes lie in a mild, temperate climate and descend to a semi-tropical one. Near the divide are extensive forests of pine, spruce, and hemlock, mingled curiously, even up to 7,000 feet above sea, with thickets of bamboo. Thence we passed down through the zones—from where the snow still lay in sheltered nooks and trees were scarcely in bud to where cherries were ripe and palms stood among the luxuriant growth of early summer. We passed the lilac and rhododendron and a large purple columbine. Where the rhododendron reached its lowest limit, at 3,500 feet above sea, were the highest of the rice fields, which are terraced into every nook of the mountain side that can be irrigated. This is the natural home of the Wichuraiana rose. It hangs in festoons over trees and cliffs, and in the higher zone just coming into blossom it bore on each graceful drooping branch hundreds of pink-white buds. Thence for sixty miles it was rarely wanting and bloomed with wonderful profusion. One vine had a stem ten inches in diameter, and completely covered, as with a veil of white lace, a tall wide-spreading tree. Single sprays hung from high branches almost to the ground, bearing quantities of blossoms and swinging with upturned ruddy tips in the breeze. Less graceful, yet charming in their way, were two mimosas, the one pale lavender, the other gorgeous yellow, and lupines and pea vines covering whole fields. But among flowers of field or mountain side none vie with the poppy, the native's pleasure and his profit. It blossomed white as a lily and red as a jacqueminot, but often, also, of that sombre sang-de-bœuf hue, the shadow tone of rosy lights, which fittingly suggests the gloom into which the Chinese are drifting with phantoms

of the opium dream. We first saw it unfolding its curling, scimeter-like leaves in the chilly upper air; then we passed on every hand its gorgeous nodding flowers; and lower down, their work done, the petals were falling and the pale green serpent's head stood up naked, not ugly in itself, but hideous in its potency of evil.

In the valley of the Pu-ho there was a well-established foot-path, suitable even for pack animals, and our difficulties were over when we crossed the summit. The way was easy to the Han River, which we reached at the walled city of Shī-chuan-hien, one hundred and ten miles from Chou-chlī-hien. We had crossed in twenty days, at a most unfavourable season, with many delays occasioned by weather and high water. Nowhere had we met with any real difficulty, and, judging by the accounts given by von Richthofen and others of the cañons through which the great southwestern highway between the Wei valley and Sze-chwan is built, the route which it takes offers much more formidable obstacles to the passage of the range than any we encountered. The pass we crossed and the approaches to it are entirely practicable for railway construction, and it is quite possible that still better ways might be found. The rocks above the active work of running streams are somewhat decayed and often soil-covered, yet firm underneath. When, in the development of the Chinese Empire, it becomes necessary to connect the valley of the Wei with that of the upper Han River at Han-chung-fu, there will be no difficulty in building that section of the great southwestern trunk line, even across the barriers of the Ts'in-ling-shan.

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## CERTAIN RELATIONS OF RAINFALL AND TEMPERATURE TO TREE GROWTH.

BY

HENRY GANNETT.

Of the various factors, climatic and otherwise, which affect the growth of forests and different species of trees, there are two which are of a primary character. These are annual temperature and annual rainfall—that is, the amount of heat and the amount of water. These two factors determine whether trees can grow, and if so, what species.

There are numerous other factors which have a modifying effect, among which are seasonal temperatures, seasonal rainfall,